

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				
Pearson Edexcel Level 1/Level 2 GCSE (9–1)					<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>				
Tuesday 11 June 2019									
Morning (Time: 1 hour 30 minutes)					Paper Reference 1MA1/3H				
Mathematics Paper 3 (Calculator) Higher Tier									
You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.								Total Marks <input type="text"/>	

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You must **show all your working**.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- **Calculators may be used.**
- If your calculator does not have a π button, take the value of π to be 3.142 unless the question instructs otherwise.




Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over 

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6/7/1/1/1/1/1



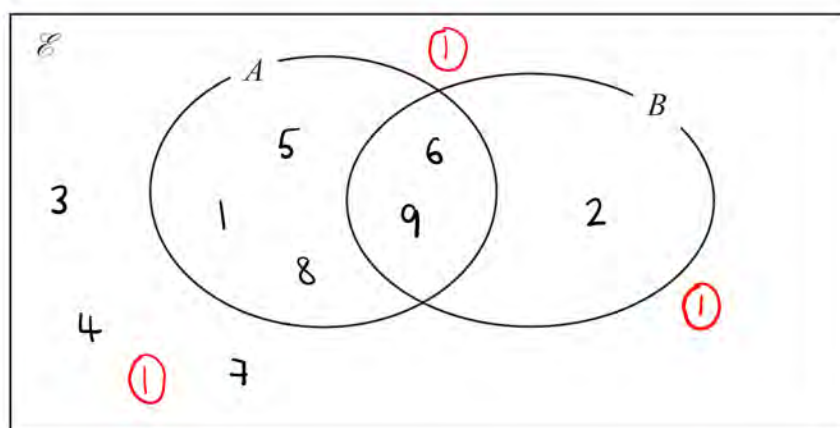

Pearson

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1 $\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ universal set
 $A = \{1, 5, 6, 8, 9\}$
 $B = \{2, 6, 9\}$



- (a) Complete the Venn diagram to represent this information.

(3)

A number is chosen at random from the universal set \mathcal{E} .

- (b) Find the probability that the number is in the set $A \cap B$

2 numbers in set A and set B.

9 numbers in total. ①

$$P(A \cap B) = \frac{2}{9}$$

$$\frac{2}{9}$$

(2)

(Total for Question 1 is 5 marks)

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- 2 Katy invests £200 000 in a savings account for 4 years.
The account pays compound interest at a rate of 1.5% per annum.

Calculate the total amount of interest Katy will get at the end of 4 years.

$$£200\,000 \times 1.015^4 = £212272.7101 \quad (1)$$

Total amount of interest after 4 years

$$= \text{total amount after 4 years} - \text{original amount}$$

Total amount of interest after 4 years

$$= £212272.7101 - £200000 \quad (1)$$

$$= £12272.7101\dots$$

(1)

£ 12272.71

(Total for Question 2 is 3 marks)



3 The table shows information about the heights of 80 plants.

Midpoint	Height (h cm)	Frequency	C. f.
15	$10 < h \leq 20$	7	7
25	$20 < h \leq 30$	13	20
35	$30 < h \leq 40$	14	34
45	$40 < h \leq 50$	12	46
55	$50 < h \leq 60$	16	62
65	$60 < h \leq 70$	18	80

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(a) Find the class interval that contains the median.

80 plants. $\frac{80}{2} = 40$

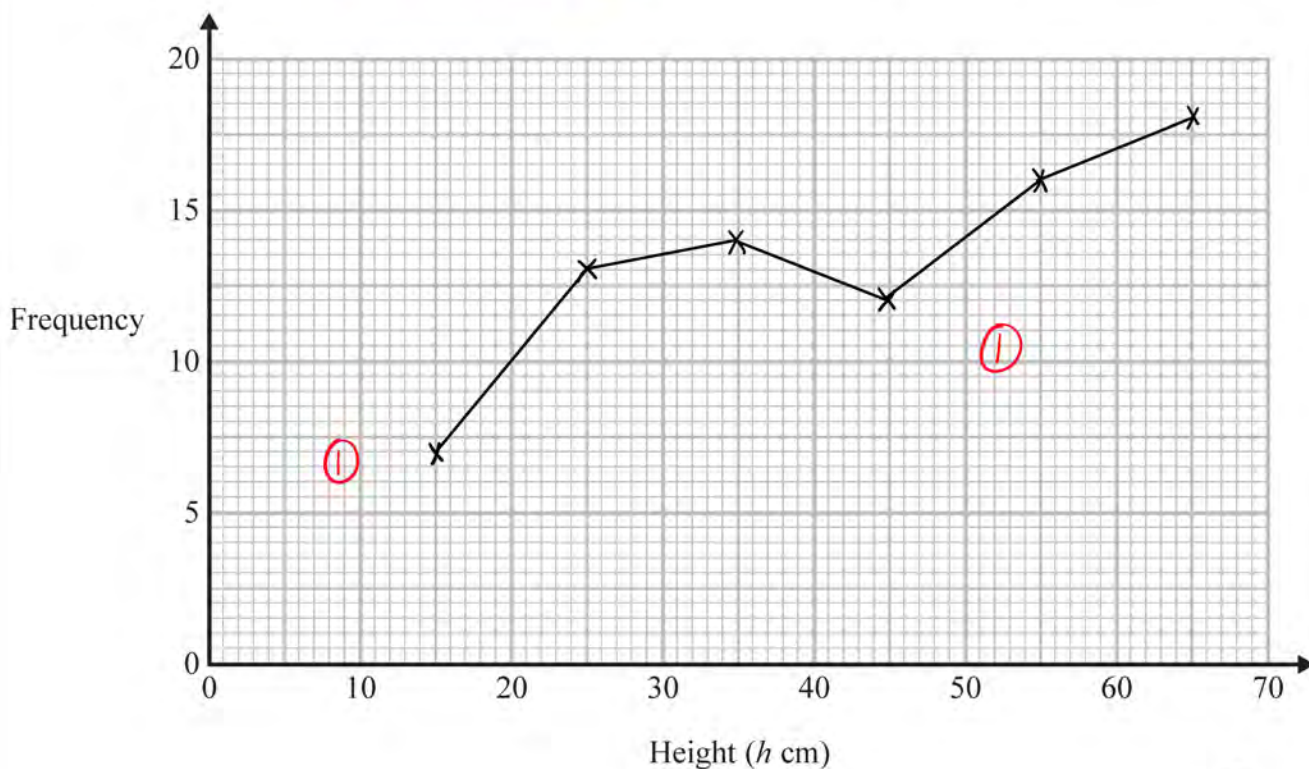
\therefore median is at 40th position.

①

$40 < h \leq 50$

(1)

(b) On the grid, draw a frequency polygon for the information in the table.

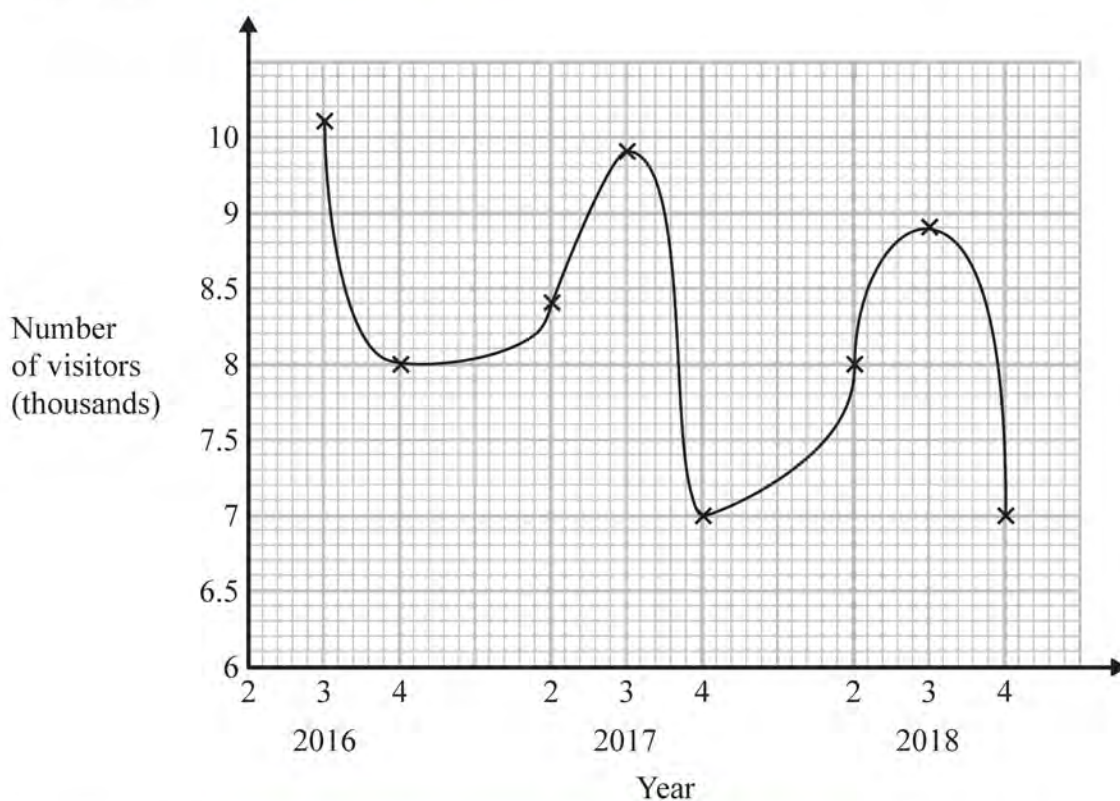


(2)

(Total for Question 3 is 3 marks)



- 4 Sean has drawn a time series graph to show the numbers, in thousands, of visitors to a fun park.



Write down two things that are wrong or could be misleading with this graph.

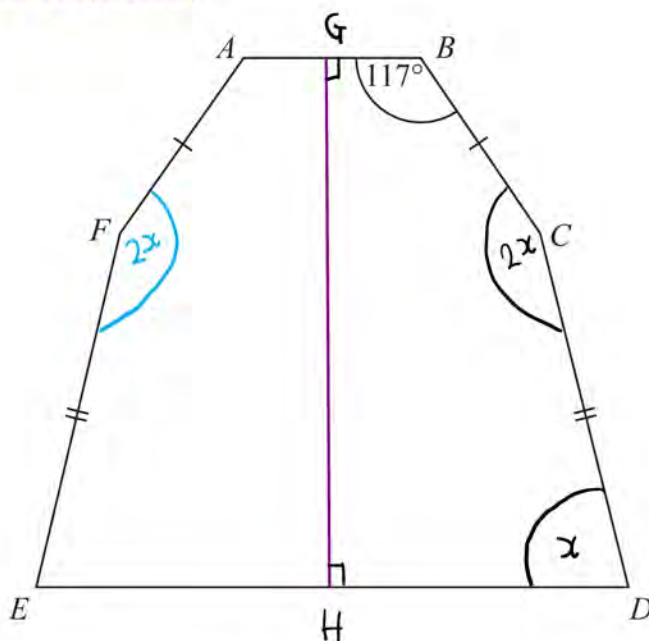
1 The lines joining the points should be straight, so he should have used a ruler. (1)

2 It is not clear what 2, 3, 4 on the x-axis means. (1)

(Total for Question 4 is 2 marks)



- 5 The diagram shows a hexagon.
The hexagon has one line of symmetry.



$FA = BC$

$EF = CD$

Angle $ABC = 117^\circ$

Shape $BCDGH$ is a pentagon.

Angle $BCD = 2 \times \text{angle } CDE$

Work out the size of angle AFE .
You must show all your working.

Sum of interior angles in a pentagon

$= (5-2) \times 180 = 540^\circ$ ①

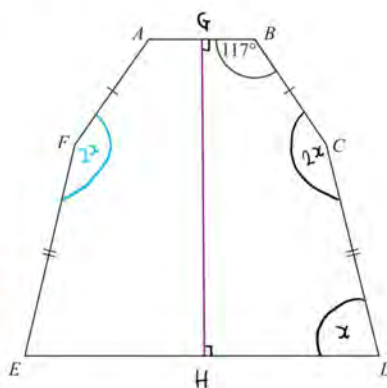
$117^\circ + 90^\circ + 90^\circ + 2x + x = 540^\circ$

$297^\circ + 3x = 540^\circ$

$3x = 243^\circ$
 $\div 3 \quad \therefore x = 81^\circ$ ①

$\angle BCD = \angle AFE = 2x$ ①

$\therefore \angle AFE = 2x = 2 \times 81^\circ$
 $= \underline{\underline{162^\circ}}$



①

162

(Total for Question 5 is 4 marks)

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6 Jeremy has to cover 3 tanks completely with paint.

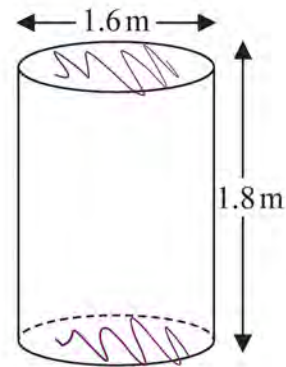
Each tank is in the shape of a cylinder with a top and a bottom. The tank has a diameter of 1.6 m and a height of 1.8 m.

Jeremy has 7 tins of paint.

Each tin of paint covers 5 m^2

Has Jeremy got enough paint to cover completely the 3 tanks?

You must show how you get your answer.



SURFACE AREA OF ONE TANK

$$= 2\pi r h + 2\pi r^2 \quad (1)$$

$$= (2\pi (0.8)(1.8)) + (2\pi (0.8)^2)$$

$$= 2.88\pi + 1.28\pi = 4.16\pi \text{ m}^2$$

SURFACE AREA OF THREE TANKS

$$= 3 \times (4.16\pi) = 12.48\pi \text{ m}^2 \approx 39.20707... \text{ m}^2 \quad (1)$$

AMOUNT OF PAINT JEREMY HAS

$$= 7 \times 5 = 35 \text{ m}^2 \quad (1)$$

JEREMY ONLY HAS 35 m^2 OF PAINT, BUT HE NEEDS $39.2... \text{ m}^2$ OF PAINT.

$$35 < 39.2 \quad (1)$$

\therefore JEREMY DOES NOT HAVE ENOUGH PAINT.

(Total for Question 6 is 5 marks)



7 Work out $\sqrt{\frac{2.5 \times \sin 43^\circ}{8.2^2 - 50.5}}$

Give your answer correct to 3 significant figures.

$$\sqrt{\frac{2.5 \times \sin 43}{8.2^2 - 50.5}} = \sqrt{\frac{2.5 \times \sin 43}{16.74}} \quad \textcircled{1}$$

$$= 0.3191419855... \approx \underline{\underline{0.319}} \quad (3\text{s.f.})$$

①

0.319

(Total for Question 7 is 2 marks)

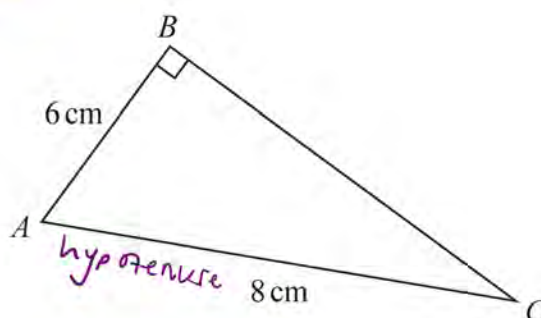
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- 8 ABC is a right-angled triangle.



Here is Sarah's method to find the length of BC .

$$\begin{aligned}
 BC^2 &= AB^2 + AC^2 \\
 &= 6^2 + 8^2 \\
 &= 100 \quad a^2 + b^2 = c^2, \text{ where } c \text{ is the hypotenuse.} \\
 BC &= 10
 \end{aligned}$$

- (a) What mistake has Sarah made in her method?

She thought that BC was the hypotenuse when it was actually AC .

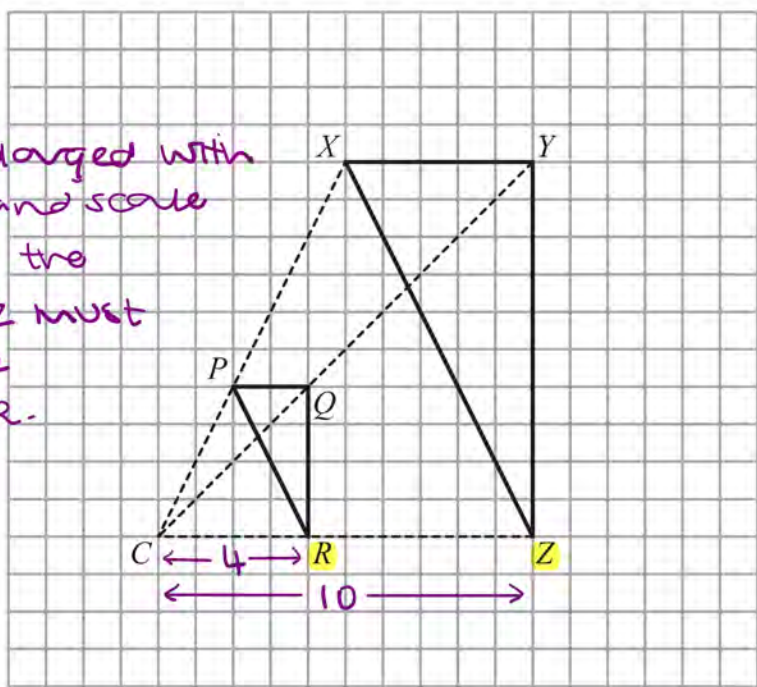


(1)



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If PQR is enlarged with centre C and scale factor 1.5 , the distance CZ must be $1.5 \times$ the distance CR .



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Roy is going to enlarge triangle PQR with centre C and scale factor $1\frac{1}{2}$

He draws triangle XYZ .

(b) Explain why Roy's diagram is **not** correct.

The scale factor that Roy used is not 1.5 . (1)

(1)

(Total for Question 8 is 2 marks)

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9 A company has to make a large number of boxes.

The company has 6 machines.

All the machines work at the same rate.

When all the machines are working, they can make all the boxes in 9 days.

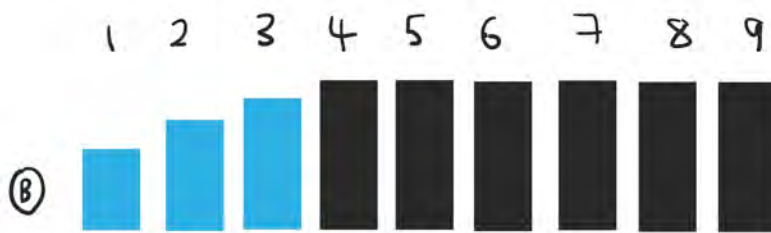
The table gives the number of machines working each day.

	day 1	day 2	day 3	all other days
Number of machines working	3	4	5	6

Work out the total number of days taken to make all the boxes.



If 6 machines were working each day, it would take 9 days to make all the boxes.



It takes 9 full bars to make all the boxes.

These 3 days have a total of 12 machines working. This is equivalent to 2 full bars.

① 10

(Total for Question 9 is 3 marks)



In 9 days, we only have 8 full bars. But it takes 9 full bars to make all the boxes.



And so we need a tenth day to have 9 full bars and make all the boxes.

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- 10 Marie invests £8000 in an account for one year.
At the end of the year, interest is added to her account.

Marie pays tax on this interest at a rate of 20%
She pays £28.80 tax.

Work out the percentage interest rate for the account.

$$8000 \times a = 8000a$$

a is the multiplier that represents an increase by a certain percentage

this is the amount in her account at the end of the year.

$$\text{Amount of interest} = 8000a - 8000$$

$$20\% \text{ of this interest} = £28.80 \quad (1)$$

$$\therefore (0.2) \times (8000a - 8000) = 28.80$$

$$1600a - 1600 = 28.80$$

$$\begin{aligned} \div 1600 \left(\begin{array}{l} 1600a = 1628.80 \\ a = 1.018 \end{array} \right) \div 1600 \quad (1) \end{aligned}$$

Multiplier of 1.018 = Increase of 1.8%

\therefore percentage increase rate

$$= \underline{\underline{1.8\%}}$$

(1)

1.8 %

(Total for Question 10 is 3 marks)



11 In May 2019, the distance between Earth and Mars was 3.9×10^7 km.

In May 2019, a signal was sent from Earth to Mars.

Assuming that the signal sent from Earth to Mars travelled at a speed of 3×10^5 km per second,

(a) how long did the signal take to get to Mars?

$$\text{speed} = \frac{\text{distance}}{\text{time}} \quad \therefore \quad \text{time} = \frac{\text{distance}}{\text{speed}}$$

$$\text{time} = \frac{3.9 \times 10^7}{3 \times 10^5} \quad \therefore \quad \text{time} = \underline{\underline{130}} \text{ seconds}$$

①

①

130

seconds

(2)

The speed of the signal sent from Earth to Mars in May 2019 was actually less than 3×10^5 km per second.

(b) How will this affect your answer to part (a)?

The answer to part (a) will be bigger.

①

(1)

(Total for Question 11 is 3 marks)

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12 Patrick has to work out the exact value of $64^{\frac{1}{4}}$

Patrick says,

“ $\frac{1}{4}$ of 64 is 16 so $64^{\frac{1}{4}} = 16$ ”

$$64^{\frac{1}{4}} = \sqrt[4]{64}$$

Explain what is wrong with what Patrick says.

$64^{\frac{1}{4}}$ means the fourth root of 64, not a quarter of 64. ①

(Total for Question 12 is 1 mark)



- 13 The density of ethanol is 1.09 g/cm^3
The density of propylene is 0.97 g/cm^3

60 litres of ethanol are mixed with 128 litres of propylene to make 188 litres of antifreeze.

Work out the density of the antifreeze.

Give your answer correct to 2 decimal places.

$$\left. \begin{array}{l} 1 \text{ litre} = 1000 \text{ cm}^3 \\ \text{Density} = \frac{\text{mass}}{\text{volume}} \end{array} \right\} \begin{array}{l} 60 \text{ L of ethanol} = 60,000 \text{ cm}^3 \\ 128 \text{ L of propylene} = 128,000 \text{ cm}^3 \end{array}$$

Find mass of 60 L of ethanol:

$$\begin{aligned} \text{mass} &= \text{density} \times \text{volume} \quad (1) \\ &= 1.09 \times 60,000 = 65,400 \text{ g} \end{aligned}$$

Find mass of 128 L of propylene:

$$\text{mass} = 0.97 \times 128,000 = 124,160 \text{ g} \quad (1)$$

\therefore total mass of antifreeze

$$= 65,400 + 124,160 = 189,560 \text{ g}$$

(1)

$$\dots\dots\dots 1.01 \dots\dots\dots \text{ g/cm}^3$$

(Total for Question 13 is 4 marks)

Density of antifreeze

$$= \frac{\text{mass of antifreeze}}{\text{volume of antifreeze}} = \frac{189,560}{188,000} \quad (1)$$

$$= 1.00829787\dots \text{ g/cm}^3 \approx \underline{\underline{1.01 \text{ g/cm}^3}} \text{ (2 dp)}$$

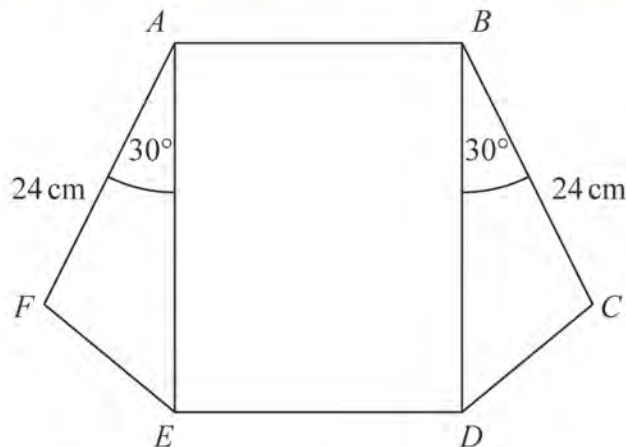
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- 14 The diagram shows a rectangle, $ABDE$, and two congruent triangles, AFE and BCD .



area of rectangle $ABDE$ = area of triangle AFE + area of triangle BCD

$$AB : AE = 1 : 3$$

Work out the length of AE .

$$\text{Area of } \triangle AFE = \text{Area of } \triangle BCD = \frac{1}{2} ab \sin C.$$

$$\frac{1}{2} ab \sin C = \left(\frac{1}{2}\right)(24)(AE)(\sin 30) = 6AE. \quad (1)$$

$$\therefore \text{Area of } \square ABDE = 6AE + 6AE = 12AE. \quad (1)$$

$$\text{Let } AB = x \text{ and } AE = 3x. \quad (1)$$

$$\text{Area of } \square ABDE = (x)(3x) = 3x^2$$

$$\text{Area of } \square ABDE = 12AE = 12(3x) = 36x \quad (1)$$

$$\therefore \cancel{3x^2} = \cancel{36x} \quad \dots\dots\dots 36 \dots\dots\dots \text{cm}$$

$$3x = 36$$

(Total for Question 14 is 4 marks)

$$AE = 3x = \underline{\underline{36 \text{ cm}}}.$$

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- 15 The graph of the curve C with equation $y = f(x)$ is transformed to give the graph of the curve S with equation $y = f(-x) - 3$

The point on C with coordinates $(7, 2)$ is mapped to the point Q on S.

Find the coordinates of Q.

$$y = f(x) \rightarrow (7, 2)$$

$$y = f(-x) \rightarrow (-7, 2)$$

NOTE:
 $f(-ax)$ would mean multiply
 x -coordinate by $-\frac{1}{a}$

Multiply the x -coordinate by $-\frac{1}{1}$ ①

$$y = f(-x) - 3 \rightarrow (-7, -1) \text{ ①}$$

subtract 3 from the y -coordinate. $(-7, -1)$

(Total for Question 15 is 2 marks)

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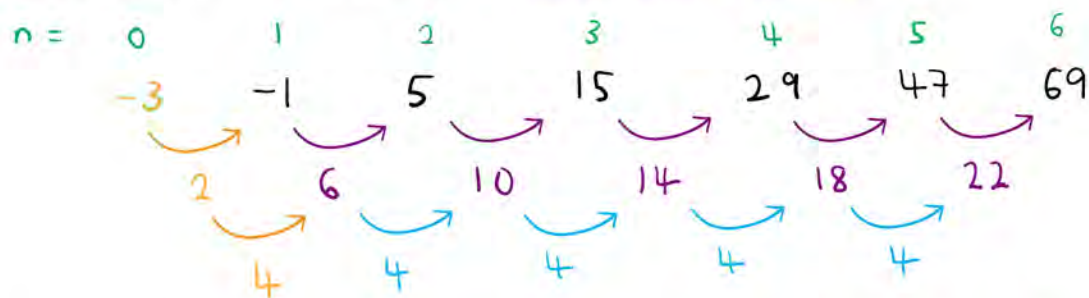
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16 Here are the first six terms of a quadratic sequence.

-1 5 15 29 47 69

Find an expression, in terms of n , for the n^{th} term of this sequence.



$$n^{\text{th}} \text{ term: } an^2 + bn + c.$$

$$a = \frac{\text{2nd difference}}{2} = \frac{4}{2} = 2 \quad \textcircled{1}$$

$$c = 0^{\text{th}} \text{ term} = -3 \quad \textcircled{1}$$

$$a = 2, b = 0, c = -3.$$

$$\therefore n^{\text{th}} \text{ term} = \underline{\underline{2n^2 - 3}}$$

To find b : (let $n=1$)

$$an^2 + bn + c$$

$$2(1^2) + b(1) - 3 = -1$$

$$2 + b - 3 = -1$$

$$\therefore b = 0$$

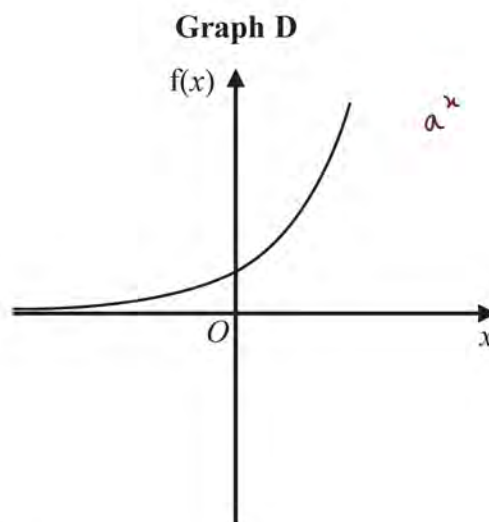
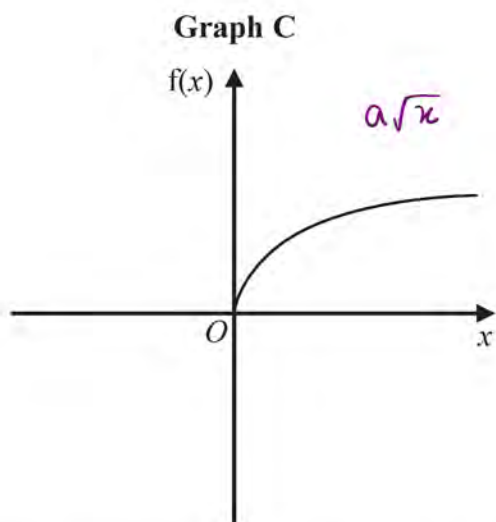
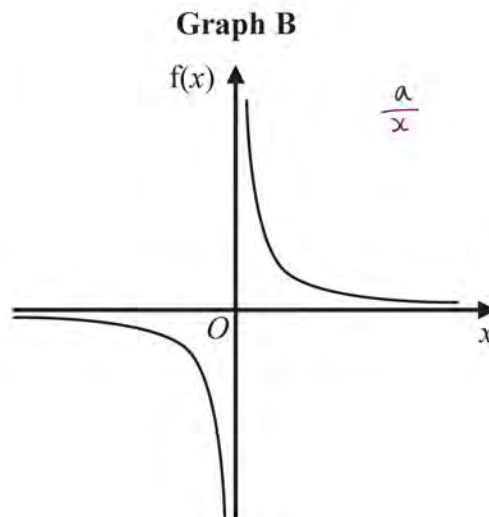
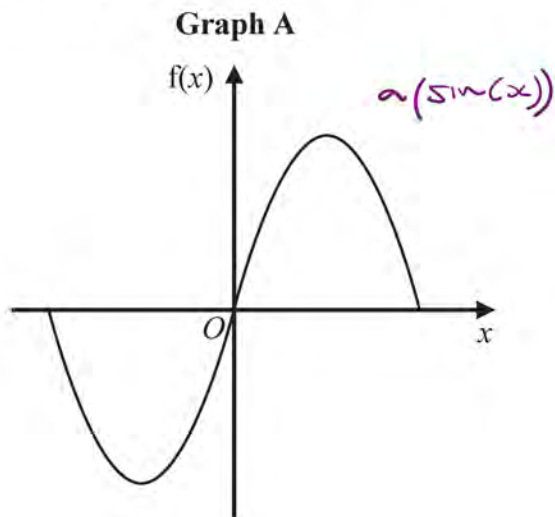
①

$$2n^2 - 3$$

(Total for Question 16 is 3 marks)



17 Here are four graphs.



The graphs represent four different types of function f .

Match each description of the function in the table to the letter of its graph.

Description of function	Graph
$f(x) \propto \frac{1}{x}$ ←	B
$f(x)$ is a trigonometrical function	A
to the power of x ←	D
$f(x)$ is directly proportional to \sqrt{x}	C

① ①
 → $\sin(x), \cos(x), \tan(x), \text{etc.}$
 → $f(x) \propto \sqrt{x}$

(Total for Question 17 is 2 marks)



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18 (a) Show that $(2x + 1)(x + 3)(3x + 7)$ can be written in the form $ax^3 + bx^2 + cx + d$ where a, b, c and d are integers.

$$(2x + 1)(x + 3) = 2x^2 + 6x + x + 3 = 2x^2 + 7x + 3. \quad (1)$$

$$(2x^2 + 7x + 3)(3x + 7)$$

$$= 6x^3 + 21x^2 + 9x + 14x^2 + 49x + 21 \quad (1)$$

$$= \underline{\underline{6x^3 + 35x^2 + 58x + 21}} \quad (1)$$

(3)

(b) Solve $(1-x)^2 < \frac{9}{25}$

$$\left. \begin{array}{l} (1-x)^2 < \frac{9}{25} \\ \text{Sq. root both sides.} \\ 1-x < \pm \frac{3}{5} \quad (1) \end{array} \right\} \begin{array}{l} \text{using } + \frac{3}{5}: \\ 1-x < \frac{3}{5} \\ 1 < \frac{3}{5} + x \\ \frac{2}{5} < x \end{array}$$

$$\left. \begin{array}{l} \text{using } - \frac{3}{5}: \\ 1-x < -\frac{3}{5} \\ -1+x > \frac{3}{5} \\ x > \frac{8}{5} \end{array} \right\} (1)$$

When you multiply both sides by a negative number, the inequality sign changes.

$$\frac{2}{5} < x \text{ and } x > \frac{8}{5}$$

$$\frac{2}{5} < x < \frac{8}{5}$$

(1)

$$\underline{\underline{\frac{2}{5} < x < \frac{8}{5}}}$$

(3)

(Total for Question 18 is 6 marks)

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$$19 \quad D = \frac{u^2}{2a}$$

$u = 26.2$ correct to 3 significant figures

$a = 4.3$ correct to 2 significant figures

- (a) Calculate the upper bound for the value of D .
Give your answer correct to 6 significant figures.
You must show all your working.

$$26.15 \longleftarrow 26.2 \longrightarrow 26.25$$

①

$$4.25 \longleftarrow 4.3 \longrightarrow 4.35$$

$$\text{U.B. for } D = \frac{(\text{U.B. for } u)^2}{2(\text{L.B. for } a)} = \frac{26.25^2}{2(4.25)}$$

①

$$= 81.06617647... \approx \underline{\underline{81.0662}} \text{ (6sf)}$$

①

$$\underline{\underline{81.0662}}$$

(3)

The lower bound for the value of D is 78.6003 correct to 6 significant figures.

- (b) By considering bounds, write down the value of D to a suitable degree of accuracy.
You must give a reason for your answer.

①

$D = 80$ because the bounds are the same when rounded to the nearest ten. ①

(2)

(Total for Question 19 is 5 marks)

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20 Solve algebraically the simultaneous equations

$$x^2 - 4y^2 = 9$$

$$3x + 4y = 7$$

<p>① $3x + 4y = 7$</p> <p>$3x = 7 - 4y$</p> <p>$x = \frac{7 - 4y}{3}$ ①</p>	<p>② $x^2 - 4y^2 = 9$</p> <p>$\left(\frac{7 - 4y}{3}\right)^2 - 4y^2 = 9$</p> <p>$\frac{49 - 56y + 16y^2}{9} - 4y^2 = 9 \equiv \frac{36y^2}{9}$ ①</p>
--	--

$$\textcircled{3} \quad \frac{49 - 56y + 16y^2}{9} - \frac{36y^2}{9} = 9 \quad \therefore \quad \frac{49 - 56y + 16y^2 - 36y^2}{9} = 9$$

$$49 - 56y + 16y^2 - 36y^2 = 81 \quad 16y^2 - 36y^2 = -20y^2$$

$$-32 - 56y - 20y^2 = 0 \quad \therefore \quad -20y^2 - 56y - 32 = 0 \quad \text{we can multiply both sides by } -1$$

$$20y^2 + 56y + 32 = 0 \quad \xrightarrow{\div 4} \quad 5y^2 + 14y + 8 = 0 \quad \textcircled{1}$$

$$\textcircled{4} \quad 5y^2 + 14y + 8 = 0$$

$$(5y + 4)(y + 2) = 0$$

$$\therefore y = -2, y = -\frac{4}{5}$$

$$x = \frac{7 - 4y}{3} \quad \textcircled{1}$$

$$\textcircled{5} \quad \text{when } y = -2:$$

$$x = \frac{7 - 4(-2)}{3} = 5 \quad x = 5, y = -2$$

$$\text{when } y = -\frac{4}{5}:$$

$$x = \frac{7 - 4\left(-\frac{4}{5}\right)}{3} = \frac{17}{5} \quad x = \frac{17}{5}, y = -\frac{4}{5}$$

$x = 5, y = -2 \text{ and } x = \frac{17}{5}, y = -\frac{4}{5}$

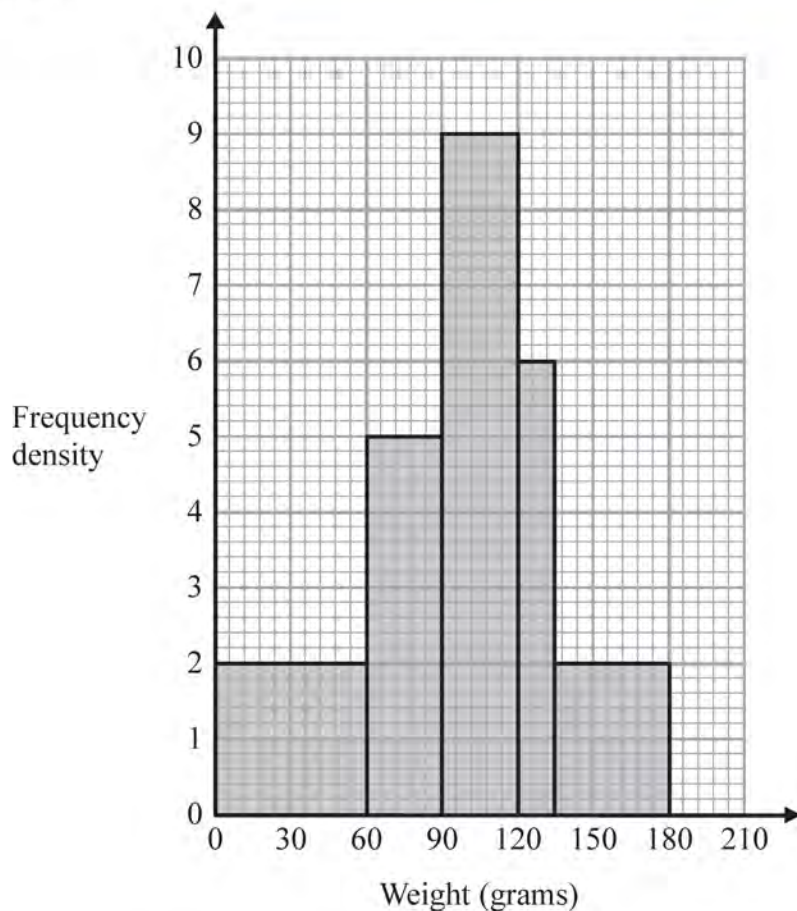
①

$$x = 5, y = -2 \text{ and } x = \frac{17}{5}, y = -\frac{4}{5}$$

(Total for Question 20 is 5 marks)



- 21 The histogram gives information about the distribution of the weights of some onions grown by a farmer.



Onions less than 60 grams in weight are used for pickling.
Onions greater than 120 grams in weight are sold at the market.
The rest of the onions are sent to a food processing factory.

Find total frequency :

$$\text{frequency} = \text{f. d.} \times \text{classwidth} = \text{area of each bar.} \quad (1)$$

$$\therefore \text{total frequency} = \text{total area of all bars}$$

$$= (2 \times 60) + (5 \times 30) + (9 \times 30) + (6 \times 15) + (2 \times 45) = 720.$$

$$\text{Number of onions less than } 60\text{g} = 60 \times 2 = 120$$

$$\text{Number of onions more than } 120\text{g} = (6 \times 15) + (2 \times 45) = 180$$

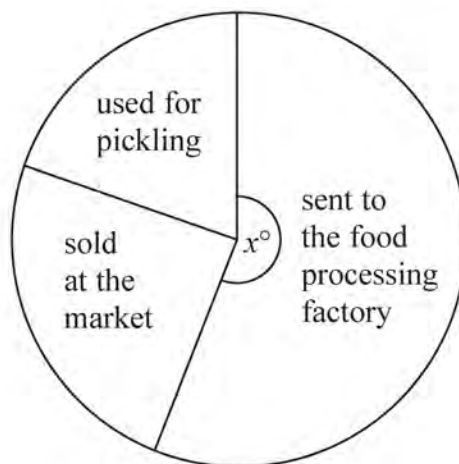
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A pie chart is drawn using the information opposite to show what the farmer does with the onions he grows.



The angle of the sector for the onions sent to the food processing factory is x° .

Work out the value of x .

$$\frac{120}{720} \text{ onions} < 60g \text{ and } \frac{180}{720} \text{ onions} > 120g. \quad (1)$$

$$\therefore \text{Number of onions sent to factory} = 720 - (120 + 180) = 420.$$

$$x = \frac{420}{720} \times 360^\circ = 210^\circ \quad (1)$$

(1)

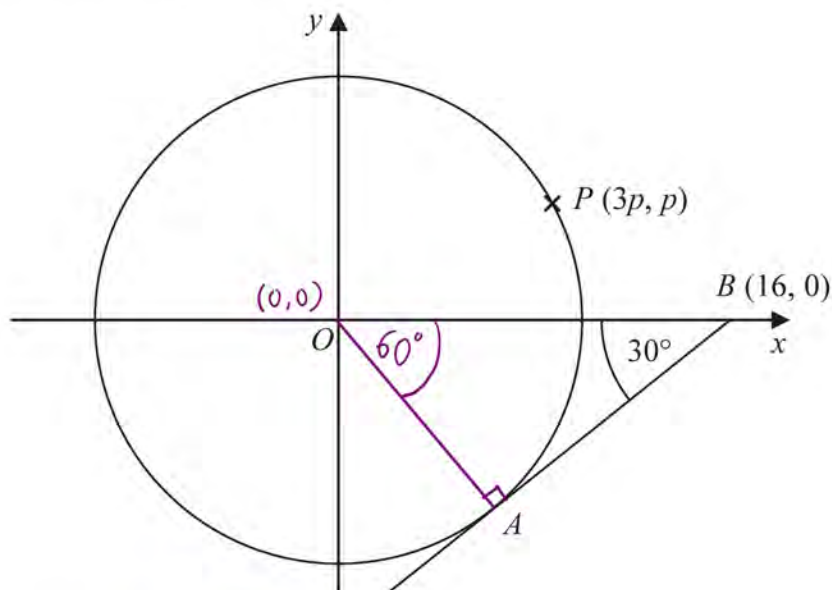
Angles in a circle
add up to 360° .

$$x = 210^\circ$$

(Total for Question 21 is 4 marks)



22 The diagram shows a circle, centre O .



AB is the tangent to the circle at the point A .

Angle $OBA = 30^\circ$

Point B has coordinates $(16, 0)$

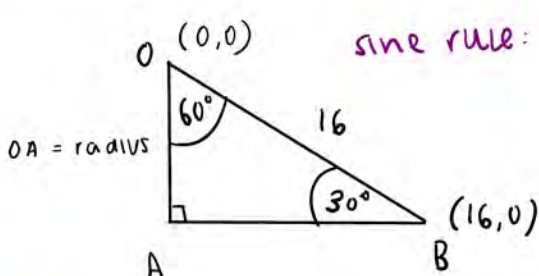
Point P has coordinates $(3p, p)$

Angle between tangent and radius = 90°

Find the value of p .

Give your answer correct to 1 decimal place.

You must show all your working.



sine rule: $\frac{\sin 90}{16} = \frac{\sin 30}{OA}$

$$\frac{1}{16} = \frac{1/2}{OA}$$

$$OA = 16 \times \frac{1}{2} = 8.$$

① $x^2 + y^2 = r^2 \rightarrow r = 8 \therefore x^2 + y^2 = 8^2$

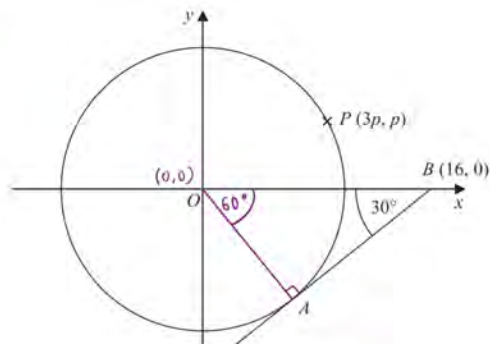
Point $P(3p, p) \rightarrow x = 3p, y = p.$

$\therefore (3p)^2 + p^2 = 8^2$ ①

$$9p^2 + p^2 = 8^2$$

$$10p^2 = 64$$

$$p^2 = \frac{64}{10} \therefore p = \sqrt{\frac{64}{10}} = \underline{\underline{2.5}} \text{ (1 d.p.)}$$

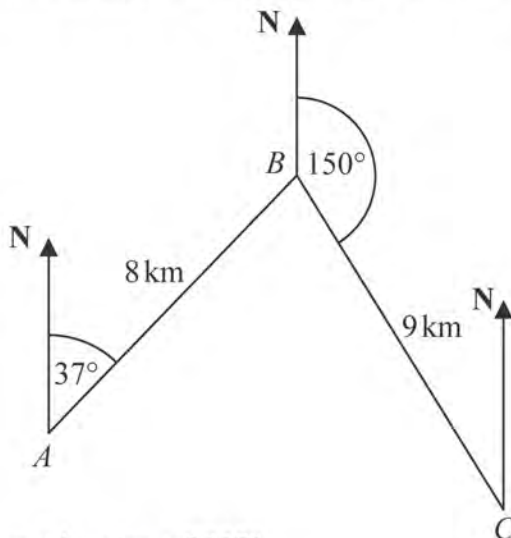


① $p = \underline{\underline{2.5}}$

(Total for Question 22 is 4 marks)



23 The diagram shows the positions of three towns, Acton (A), Barston (B) and Chorlton (C).



Barston is 8 km from Acton on a bearing of 037°
 Chorlton is 9 km from Barston on a bearing of 150°

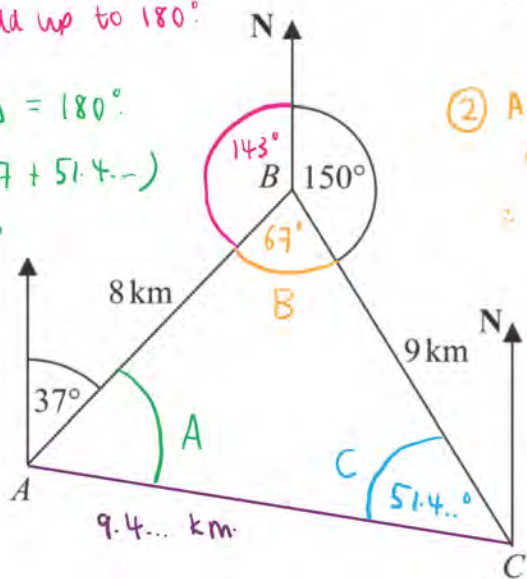
Find the bearing of Chorlton from Acton.
 Give your answer correct to 1 decimal place.
 You must show all your working.

① co-interior angles add up to 180°

$$\text{Bearing} = 37 + A^\circ$$

⑤ Angles in $\Delta = 180^\circ$
 $A = 180 - (67 + 51.4\dots)$
 $= 61.5786\dots^\circ$

② Angles around a point add up to 360°
 $\therefore B = 360 - (150 + 143) = 67^\circ$



④ Sine rule: $\frac{\sin C}{8} = \frac{\sin 67}{9.4\dots}$

$$(9.4\dots) \sin C = 8 (\sin 67)$$

① $\sin C = 0.78175\dots$
 $\therefore C = 51.42131479\dots^\circ$

③ Find length AC using cosine rule:

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$AC^2 = 8^2 + 9^2 - (2 \times 8 \times 9 \times (\cos 67))$$

$$AC^2 = 88.7347175\dots$$

①

$$\therefore AC = 9.419910695\dots \text{ km}$$

⑥ Bearing = $37 + A$
 $= 37 + 61.5786\dots$
 $= \underline{098.6^\circ} \text{ (1d.p.)}$ ①

098.6

(Total for Question 23 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS



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